Research Article

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Minimally Invasive Aesthetic Crown Lengthening: A Piezoelectric Assisted Case Series with 4-Year Follow-Up

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ABSTRACT

Aim: *This retrospective study aims to reveal the clinical outcome at 48 months of a minimally invasive crown lengthening technique performing an intrasurcular flapless osteotomy, using a piezoelectric tip designed for this purpose.*

Material and Methods: *All subjects in the current case series required esthetic crown lengthening procedures in the anterior esthetic zone of the maxilla. Prosthetic planning was carried out, which included a digital wax-up of the ideal tooth morphology, which allowed constructing a surgical guide to transfer the proposed gingival margins to the patient. Gingivectomy was performed by using an electrosurgery system Perfect TCS II™ (Coltene Whaledent) and osteotomy by using a piezoelectric insert PiezoSmile™ (BROK) until achieving a bone crest-gingival margin distance similar to the presurgical.*

Results: *57 patients were followed postoperatively for 48 months. During the post-operative period, healing, complications, periodontal and aesthetic health parameters including the position of the gingival margin were observed. WES, PES and RES indexes showed an optimal integration with the restorative materials and a good aesthetic result.*

Conclusion: *Minimally invasive crown lengthening technique with electrosurgery and a piezoelectric insert is effective in repositioning the gingival margin in a stable and predictable manner within a 48 months follow-up.*

Keywords

Crown lengthening, Gingivectomy, Piezoelectric insert.

Introduction

Thirty percent (30%) of patients when smile show gingiva over the upper central incisors [1]. This gingival smile can be produced due to an excess of maxillary in a vertical sense, a short and hyperactive upper lip, altered passive eruption or combination of such factors [2]. Crown lengthening is one of the most common procedures in periodontal practice, representing about 10% of all surgical procedures [3]. The use of minimally invasive surgical techniques is a trend in dentistry due to the good clinical results obtained with minimal complications during the post-operative phase [4-6] and reduced consumption of anti-inflammatories, which is translated

into a shorter time required by the patient to return to their normal activities [7].

In the field of dentistry, new technologies have arisen to improve minimally invasive surgical techniques, these includes, the use of surgical microscope, computerized tomography surgeries and the use of planning software among others [8-11]. The use of these technologies has promoted advanced in surgical techniques, such as the development of conservative flaps, gingival recession covering, interdental papilla loss treatments and immediate implant placement surgery, among others [7,10-12]. All surgeries are done with high level of success and reduced morbidity.

One of the indications for minimally invasive surgery is the lengthening of the clinical crown due to aesthetic reasons, mainly because of alterations in passive eruption [13,14]. One of its types, 1B, corresponds to a broad keratinized gingiva band, a mucogingival line apical to cementoenamel junction (CEJ) and vestibular bone localized at CEJ level, where the simple removal of gingival tissue is not enough to lengthen the clinical crown in a predictable manner [15,16].

The use of electrosurgery has been described for gingivectomies, showing predictable results and minimum adverse effects [17], while the osteotomy carried out with a piezoelectric tip has the potential to remove bone with precision and minimal soft tissue and dental radicular surface damage [18,19].

The aim of this case series report is to show the clinical outcome of 57 subjects to 48 (±6) months after a minimally invasive intrasurcular technique used for crown lengthening, by performing a gingivectomy with electrobisturí Perfect TCS II™ (Coltene Whaledent) assisted by a digital surgical guide and a controlled osteotomy with piezoelectric insert PiezoSmile™ (BROK).

Material and Methods

In this retrospective study, all patients of this case series required crown-lengthening procedures in the anterior esthetic zone of the maxilla. Subjects were informed in detail about the nature and potential risks of the procedures to be performed and the informed consent was signed. After anamnesis, clinical and radiographic examination, photographic/video record, obtaining virtual bimax printing and respective imaging, 57 patients were included. Patients were healthy and without a smoking habit. At the digital planning phase, it was determined that a previous harmonization of the zeniths, mainly through crown lengthening (Figure 1) was needed. Before surgery, in each tooth involved, the keratinized tissue width, gingival margin, gingival thickness, (probe visibility), probing depth, clinical attachment level and supracrestal connective tissue attachment were evaluated. When planning the coverage of gingival recession, recession type by Cairo, recession depth, presence of step, presence of CEJ and vestibular depth, were considered [20]. All these factors were evaluated with a periodontal probe of North Carolina (PPNC- Hu-Friedy), then PES WES and RES analysis was carried out. Patients were subjected to conventional periodontal treatment with a personalized oral hygiene instruction.

With the use of a digital surgical guide, a gingivectomy was carried out with electrosurgery Perfect TCS II™ (Coltene Whaledent) that minimizes bleeding by allowing adequate visualization of the procedures and taking care of preserving papillary integrity. Minimally invasive intrasurcular osteotomy was performed by using the PiezoSmile™ (BROK), by introducing the active part under the new gingival margin, taking care to preserve the dental root integrity by keeping the smooth face resting on the tooth and rough-serrated face towards the bucal and apical in order to carry out a controlled osteotomy, until achieving a bone crest-gingival margin distance similar to the presurgical, to finally proceed to smoothening the root surface with a gracey mini-five 1-2 curette (Hu-Friedy™).

Crown lengthening surgery was performed on teeth that were to be restored with dental resins (Figure 3), ceramic veneers (Figure 2, 4 and 5) and teeth that were not going to be restored, as well as arcades that were to be subjected to the treatment of crown lengthening and connective tissue graft (CTG) with coronally advanced flap (CAF) in the same surgical session (Figure 6). The restorative procedure was performed at 6 (± 2) weeks, except for those cases where a connective tissue graft was performed, at 12 (± 4) weeks. All these factors were evaluated at 48 (± 6) months through a new PES WES and RES indexes, separating the results by gingival thickness and restorative material used in order to objectify the analysis (Table 1, 2 and 3).

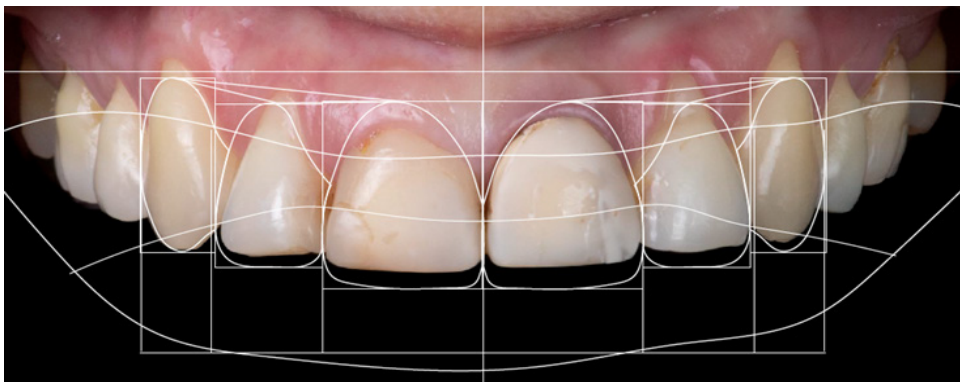


Figure 1: Digital Planning phase. It is observed that teeth 1.1 and 2.1 will require crown lengthening surgery and 1.3, 1.2, 2.2 and 2.3 will require recessions covering for zeniths harmonization.



Figure 2: Crown lengthening and restoration with ceramic veneers in alteration of passive eruption type 1B on 1.3, 1.2, 1.1, 2.1, 2.2 and 2.3. Photo A: initial; Photo B: control 10 days after crown lengthening surgery; Photo C: Control 44 months after restoration.



Figure 3: Crown lengthening in teeth 1.4, 1.2, 1.1 and 2.4 Restoration based on resin veneers. Photo A: initial and photo B: control at 48 months

Results

According to Cairo et al. [21], an objective aesthetic assessment should be used when the results of cosmetic surgeries are evaluated, but there are no findings in literature indexes that specifically evaluate aesthetic crown lengthening, before which, it has been chosen the indexes PES (Fürhauser, 2005), WES (Belser et al., 2009) and RES (Cairo, 2009) making an initial assessment and another at 48 (± 6) months post treatment by a blind evaluator.

The results in table 1 show an objective improvement of the aesthetic parameters evaluated. This objective improvement is independent of the restorative material used (able 2) and gingival thickness of the patient (Table 3). In addition, as shown in Figure 7, there was an optimal integration between the restorative material, gingiva, and tooth, together with gingival health compatible clinical signs at 48 (± 6) months post-treatment

Discussion

This cases series report shows a stable and predictable location of the gingival margin, independent of the gingival thickness and restorative material employed at 48 (± 6) months post rehabilitation, evaluated using PES, WES, and RES indexes. While there is aesthetic index of smile [22], the authors of the current study chose for these indices to be more specific in the evaluation



Figure 4: Crown lengthening in teeth 1.3, 1.2, 1.1, 2,1, 2.2 and 2.3. Restoration with ceramic veneers. Photo A: initial. Photo B: control 50 months after restoration.



Figure 5: Crown lengthening in 1.3, 1.2, 1.1, 2.1, 2.2 and 2.3. Restoration with ceramic veneers. Photo A. Initial. Photo B. Control 54 months after restorations.



Figure 6: Photo A. Initial. Photo B. Control 6 weeks after crown lengthening on teeth 1.1 and 2.1, and coronally advanced flap plus connective tissue graft on teeth 1.3, 1.2, 2.2 and 2.3. at the same surgical session. Photo C. Control 44 months after rehabilitation with ceramics veneers and crowns.



Figure 7: Control photos of minimally invasive crown lengthening surgeries. Photo A. control 48 months after ceramic veneers restoration in alteration of passive eruption type 1B. Photo B. control 54 months after ceramic veneers restoration. Photo C control 44 months after resin veneers restoration. Photo D. control 48 months after crown lengthening in unrestored teeth.

Table 1: Initial and final aesthetic evaluation by gingival thickness and restorative material (57 patients).

	CL Thin G Resin veneers Restoration No. of patients 12		CL Thick G Ceramic veneers Restoration No. of patients 23		CL Thick G Unrestored Teeth No. of patients 8		CL+CTG Thin G Ceramic veneers and crowns Restoration No. of patients 14	
	Initial	48 months control	Initial	48 months control	Initial	48 months control	initial	48 months control
Average PES x patient	12,2	13,1	12,7	13,8	11,8	13,2	12,5	13,4
Average WES x patient	6,6	7,5	5,6	9,2	3,7	3,7	3,5	9
Average RES x Patient							1	9

CL Thin G*:** Crown lengthening in thin gingiva; ***CL Thick G: crown lengthening in thick gingiva*;* ***CL + CTG Thin G:*** crown lengthening plus connective tissue graft in thin gingiva.

Table 2: Initial and final aesthetic evaluation by restorative material (57 patients).

	Resin veneers Restoration No. of patients 12		Unrestored Teeth No. of patients 8		Ceramic veneers and crowns Restoration No. of patients 37	
	Initial	48 months control	Initial	48 months control	initial	48 months control
Average PES x patient	12,2	13,1	11,8	13,2	12,5	13,8
Average WES x patient	6,6	7,5	3,7	3,7	3,5	9,2
Average RES x Patient					1	9

Table 3: Initial and final aesthetic evaluation by gingival thickness (57 patients).

	Crown lengthening in thin gingiva No. of patients 12		Crown lengthening in thick gingiva No. of patients 31		Crown lengthening plus connective tissue graft in thin gingiva. No. of patients 14	
	Initial	48 months control	Initial	48 months control	initial	48 months control
Average PES x patient	12,2	13,1	11,8	13,8	12,5	13,4
Average WES x patient	6,6	7,5	3,7	9,2	3,5	9
Average RES x Patient					1	9

of the gingival margin. However, a new index could be created for evaluation of crown lengthening and thus objectify these results.

In accordance with Zuchelli [3,23], it was observed a regrowth of the gingival margin to incisal in thick gingiva in 11% of the teeth intervened, but it was not greater than 1 mm, which could be due to an error in osteotomy, leaving a less bone crest to new gingival margin distance than original supracrestal connective insertion [24,25]. Besides, a migration towards apical of the new gingival margin not greater than 1 mm was observed in 8% of the teeth, which only occurred in thin gingiva of lateral incisors. Despite these minimum variations in the position of the new gingival margin, this current work turned out to be as predictable as those performed with conventional flap lifting technique [26]. However, in this study, the comparative advantages are less time spent for the surgical procedure, when compared with the osteotomy carried out by a micro-chisel, and the least morbidity, less healing time, and greater predictability of the gingival margin location by not use the suture and lifting of flap, as compared to the conventional technique [25,27,28]. While waiting for the final restoration, the teeth were left without provisional.

The conventional surgical procedure is usually the removal of the excess soft tissue with the lifting of a flap to perform the osteotomy up to a distance that ensures the establishment of a new insertion of supracrestal connective tissue. However, the lifting of a flap and the consequent osteotomy can have undesirable effects such as bleeding, inflammation, and post-operative pain [12,17,29]. Thus, this new procedure minimizes the effects described above and shortens surgery and restorations at a much lesser time, less than 3 to 6 months commonly accepted for restorations in the antero-superior sector [24,30]. The conventional osteotomy carried out with rotary instruments [11,15,18], has a series of disadvantages when compared with the osteotomy performed by a piezoelectric insert [31-33], among others, they requiring a flap lifting to minimize soft tissue damage or on the root surface [12], it can also generate an excess heat that alters the stability of bone tissue post-surgery [19]. Piezoelectric inserts have shown good efficiency in osteotomy procedures, with minimal thermal damage of soft tissues and radicular surface [34,35]. Additionally, it has been

observed that osteotomies performed with piezoelectric inserts have less expression of inflammatory mediators such as RANK-L and IL-1B [36,37] which could produce a better postoperative period in the patient. Clinically, the use of PiezoSmile™ shortens the clinical osteotomy and total surgery time because the length of its active part resembles the average values of supracrestal connective insertion reported in the literature.

Conclusion

This minimally invasive surgical procedure of aesthetic crown lengthening is effective and predictable in achieving stable gingival margins for restorative procedures after 48 months of evaluation.

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